MARS MICROROVER FOR MESUR PATHFINDER

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Abstract

The advent of spacecraft miniaturization promises a new generation of affordable. planetary missions; they will be more cost effective — by one to two orders of magnitude —— than those of traditional design. The first implementation of this revolutionary approach is the Mars microrover; it is scheduled to be launched on the MESUR Pathfinder mission in the Fall '96.

The Pathfinder microrover design phase started immediately after the successful concept demonstration achieved by Rocky 4. In the latter part of '91 and first half of '92, JPL performed a series of experiments that demonstrated the capability of microrovers to traverse rugged terrain reliably and perform scientific measurements.

The experiments culminated in June '92, when a complete system, consisting of a ground control station, a lander, and a fully instrumented microrover — Rocky 4 — showed the capability of the end-to-end control system and demonstinted the scientific value by obtaining good quality images of the terrain, together with a point spectrum of rock specimens in the range from visible to near-infrared. The 7 Kg Rocky 4 also deployed a microseismometer and returned a soil sample to the lander, Finally a simple percussion device showed a capability to abrade the surface layers of rocks.

The MESUR Pathfinder microrover is being designed with two sets of objectives: technological and scientific, First, we wish to obtain critical data about the Martian surface to guide future rover development, The data expected include: the mechanical properties of the soil, the characteristics of soil-rover interaction, and system-level operational data,

The scientific objectives are centered on obtaining alpha particle, proton, and X-ray (APX) spectra from a designated rock sample. Imaging from the microrover and deploying a miniature seismometer have also being considered, The long range scientific objective is preparing for missions such as MESUR *Network* and a Mars Sample Return.

The principal engineering and project challenges are: a cost limit of $25M, a mass limit of about 7 Kg, an expected landing shock of about 50 g, and severe thermal cycling on the surface. The overriding uncertainty for rover performance is caused by the unknown characteristics of the Martian surface at the landing site.

The current "reference rover" is connected by RF link to the lander. The minimum night temperature for the electronics is -40C and a "warm box" will be provided for maintaining this temperature with minimum power. The chassis has 6 wheels in a rocker-bogie configuration and is powered by 0,2 m^2 silicon solar panels, supplemented 150w-hr $LiSO_2$ batteries.

Operations on the surface of Mars will last a few weeks and will begin when the lander will allow the. rover to deploy from an attachment point on it surface. The lander camera will return a stereo panoramic image of the landing site to Earth. The panoramic view will be used to select target sites for soil mechanics tests and target rocks for APX measurements.

The science and technology team will then designate the way points to the targets. The rover will crawl away from the lander and be independent from it except through the radio link. It will use on-board "reflexive" or "behavior" control and dead reckoning to navigate safely to the targets. Highly compressed images, spectra and engineering telemetry -— resettling characteristics of wheel-soil interaction — will be transmitted to Earth through the lander at the rate of about 100 bit/s.